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# Science & Technology

## USSR: Chemistry

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UDC 577.3

**Electron Spin Echo Spectroscopy in Studies of Paramagnetic Centers of Photosynthesis**

18410013c Moscow *KHIMICHESKAYA FIZIKA* in Russian Vol 7 No 8, Aug 88 (manuscript received 3 Sep 87) pp 1047-1055

[Article by S. A. Dikanov, A. V. Astashkin, Yu. D. Tsvetkov, and M. G. Goldfeld, Institute of Chemical Kinetics and Combustion, Siberian Department, USSR Academy of Sciences, Novosibirsk, Institute of Chemical Physics, USSR Academy of Sciences, Moscow]

[Abstract] Experimental results of electron spin echo (ESE) signals obtained by various investigators were compared with available data of double electron nuclear resonance (DENR) spectroscopy; modulation effects due to  $^{14}\text{N}$  and  $^{15}\text{N}$  were analyzed; the results of the analysis of experimental data used for determination of superfine interaction (SFI) constants for nitrogen nuclei were summarized for bacteriochlorophyll a (Bcla) and chlorophyll a (Cla) cation radicals, as well as for the primary electron donors in the purple bacteria P860 photosystem and photosystem I of higher plants P700. It was shown that the use of ESE in such studies expanded the potential of EPR spectroscopy by elevating it to a new qualitative level due to the use of SFI constants rather than line widths. This method could be useful in studies of other paramagnetic centers of electron transport chain in the photosynthesis. Figures 5; references 21: 3 Russian (1 by Western author), 18 Western (5 by Russian authors).

UDC 543.535.379

**Activation of Iron Ions in Chemiluminescent Reaction of Luminol With Uniaxial Aliphatic Peroxyacids**

18410037c Kiev *UKRAINSKIY KHIMICHESKIY ZHURNAL* in Russian Vol 54 No 9 Sep 88 (manuscript received 30 Apr 87) pp 943-945

[Article by P. Z. Zagniynaya, Ya. P. Skorobogatyy, and V. K. Zinchuk, Lvov Trade Economics Institute; Lvov University]

[Abstract] The authors discovered that 1,10-phenanthroline activates iron ions in the reaction of luminol with certain peroxyacids. This process is interesting in connection with problems of chemiluminescent analysis and clarification of the nature of the activation of the catalyst in oxidation-reduction reactions. It was found that the activity of the iron ions in the chemiluminescent reaction with  $\text{C}_8\text{-C}_{13}$  peroxyacids is closely related to their activity in the reaction of the decomposition of peroxyacids. The varying effectiveness of iron ions in the decomposition of  $\text{C}_8\text{-C}_{13}$  peroxyacids is explained by the stability of the acids in an alkaline solution and their varying oxidation capacity. The activator 1,10-phenanthroline stabilizes the

catalyst, prevents hydrolysis of  $\text{Fe(III)}$ , and increases the redox potential of the system  $\text{Fe(III)/Fe(II)}$ . Figures 3, references 9: 8 Russian, 1 Western.

UDC 543.553:542.61

**Quinoxaline-2,3-Dithiol as Reagent for Concentration and Extraction-Atomic Absorption Determination of Nickel, Cobalt, and Copper In Rocks**

18410037d Kiev *UKRAINSKIY KHIMICHESKIY ZHURNAL* in Russian Vol 54 No 9, Sep 88 (manuscript received 31 Mar 87) pp 945-949

[Article by A. T. Pilipenko, O. P. Ryabushko, L. A. Batkovskaya, A. I. Samchuk, and V. O. Ryabushko, Kiev University]

[Abstract] The purpose of this work was to develop an extraction method for the concentration and separation of elements by using a sulfur-containing reagent, quinoxaline-2,3-dithiol. It has the selectivity characteristics of thiols and yields strong intracomplex compounds with sulfide-forming metals. Optimal conditions are found for the extraction of nickel, cobalt, and copper quinoxaline dithiolates in butyl alcohol as well as ionic associates in butyl alcohol and chloroform. Extraction of complexes is used as an approach for the preliminary concentration of nickel, cobalt, and copper, and separation from macrocomponents is used for their subsequent atomic absorption determination in ores and rocks. Figures 2, references 3: Russian.

UDC 678.13+541.183.5

**Porous Polymer Sorbents for Extraction of Organic Substances From Aqueous Solutions**

18410037e Kiev *UKRAINSKIY KHIMICHESKIY ZHURNAL* in Russian Vol 54 No 9, Sep 88 (manuscript received 6 Apr 87) pp 999-1001

[Article by M. T. Bryk, Ye. S. Shlyuger, V. V. Podlesnyuk, N. A. Klimenko, and R. A. Korniyenko, Institute of Colloid Chemistry and Water Chemistry, Ukrainian Academy of Sciences, Kiev]

[Abstract] A study is made of the adsorption properties of sorbents synthesized on the basis of styrene and divinylbenzene dissolved in heptane or gasoline with the addition of a polymer pore former, polydimethylsiloxane (PDMS). It was found that introducing PDMS improved the adsorption properties of the sorbents. The greatest adsorptive capacity was that of a polymer sorbent synthesized with a ratio of total monomer to PDMS of 1:0.08 and with the molecular mass of PDMS equal to 55,000. The increased adsorption volume of the polymer sorbents resulted from introducing a polymer pore former and was particularly strong in the adsorption of substances with large molecules. References 7: 6 Russian, 1 Western.

UDC 537.373.4;541.141

**Suspensions of Semiconductors with Microheterotransitions—New Type of Highly Effective Photocatalysts for Hydrogen Production From Aqueous Solutions of Hydrogen Sulfide or Sulfide Ion**

18410013d Moscow *KHIMICHESKAYA FIZIKA* in Russian Vol 7 No 8, Aug 88 (manuscript received 3 Sep 87) pp 1070-1081

[Article by Ye. N. Savinov, Yu. A. Gruzdkov, and V. N. Parmon, Institute of Catalysis, Siberian Department, USSR Academy of Sciences, Novosibirsk]

[Abstract] Easily accessible resources of hydrogen sulfide make it a promising material for photocatalytic processes aimed at storing solar energy by the breakdown of  $H_2S$  into  $H_2$  and S. Cadmium sulfide is one of the better catalysts for this reaction but the yield of hydrogen obtained with it is very low. In the present work, results showed the potential for mixed suspensions of semiconductors  $Pt-CdS/Cu_xS$  and  $Pt-Zn_yCd_{1-y}S/Cu_xS$  capable of forming microheterotransitions to give higher conversion of solar energy by higher quantum yield of the  $H_2S$  breakdown reaction and by expansion of the spectrum of photocatalytic action. These photocatalysts are easy to prepare. It is possible that the yield could be improved even more by developing optimal suspensions of  $Zn_yCd_{1-y}S$  and  $Cu_xS$  particles with specific particle size, by depositing Pt directly on the semiconductors and by obtaining a  $Cu_2S$  phase. This could produce catalysts equivalent to solar batteries with respect to their spectral characteristics and quantum yields. Figures 12; references 13: 8 Russian, 5 Western.

UDC 541.1:534.29

**Study of Effect of Acoustal Field on Course of Belousov-Zhabotinskiy Fluctuation Reaction**

18410336c Moscow *DOKLADY AKADEMII NAUK SSSR in Russian* Vol 299, No 6, Apr 88 (manuscript received 2 Sep 87) pp 1424-1427

[Article by N. A. Maksimenko and M. A. Margulis, Organic Synthesis All-Union Scientific Research Institute, Moscow; Moscow State University imeni M. V. Lomonosov]

[Abstract] The Belousov-Zhabotinskiy reaction (oxidation of malonic acid with bromate ions in the presence of cerium as a catalyst) is the most studied system in which concentration fluctuations take place. The present work studied fluctuating reactions during mechanical stirring in an acoustical field. A potentiometer was used to record the potential of the platinum redox electrode of a saturated calomel reference electrode, and an ultrasonic generator fitted with a magnetostrictured radiator (22 kHz frequency) was used to create an ultrasonic field. The specific power was varied from 1 to 20 W/cm<sup>2</sup>, and the temperature was maintained at 294 plus 0.3 K. Experimental results were obtained for two systems of malonic acid, potassium bromate ion, sulfuric acid, and cerium sulfate concentrations (with the following respective concentrations: 0.2M, 0.28M, 6M, and 0.004M [system I]; and 0.1M, 0.28M, 1.5M, and 0.001M [system II]). It was discovered that ultrasound alters the key parameters characterizing a fluctuating reaction: the time before initiation of fluctuation (induction period), the fluctuation period, the amplitude of change in fluctuation potential, and the total duration of fluctuation. Applying ultrasound after the solutions were combined resulted in a 2.6-fold drop in the induction period for system (I) and a 2.1-fold drop for system (II). At a high ultrasonic intensity (10 W/cm<sup>2</sup>) no fluctuation was observed in system (II), while at low intensities the periodic fluctuations were chaotic. Ultrasound was found to split the water molecule when it is applied to aqueous solutions. Figures 3; references 9: 4 Russian, 5 Western.

UDC 338.36:620.1.05

**Significance of Testing in Raising Technical Level  
and Quality of Production**

18410329b Moscow *KHIMICHESKOYE I  
NEFTYANOYE MASHINOSTROYENIYE* in Russian  
No 3, Mar 88 pp 38-39

[Article by Ye. N. Galperin]

[Abstract] Raising the technical level and the quality of production in the 12th Five-Year-Plan is tied to the resolution of a number of problems. The product list must be updated significantly (the amount of products manufactured within 3 years must be raised to 51 percent, which is three or more times higher than called for in the 11th Five-Year-Plan). New technology that meets world demands must be developed and introduced

(not less than 90 percent of top-level production must meet this standard by the end of the plan period). It is particularly important that the designs of products belonging to the first quality category be updated and improved (by the end of the five-year-plan, 62.5 percent of all products must deserve to be in the highest quality class), and the technical level and quality control of products must be increased (testing methods must be improved and the state acceptance must be introduced). Solving these problems entails a considerable increase in the quantity of production testing (acceptance, certification, control, etc.). Toward this end, the chemical and petroleum machine building branch of the economy has accumulated a great deal of experience in the organization of testing production. This article outlines the efforts of the Head Organizations on State Testing of Production and other organizations.

UDC 541.14

**New System For Producing Hydrogen By Photoelectrolysis of Water**

18410018a Moscow ELEKTROKHIMIYA in Russian  
Vol 24 No 7, Jul 88 (manuscript received 25 Feb 87)  
pp 907-910

[Article by G. S. Popkirov and Yu. V. Pleskov, Institute of Electrochemistry imeni A. N. Frumkin, USSR Academy of Sciences, Moscow; Central Laboratory of Solar Energy and New Energy Sources, Bulgarian Academy of Sciences, Sofia]

[Abstract] A new photoelectrochemical system is suggested for converting solar energy to hydrogen energy by means of light-stimulated decomposition of water. The photosensitive electrode is p-Si, and a homogeneous charge carrier, heteropolyacid (a compound containing two or more variable valence metal cations in the molecule) is introduced into the solution. Their catalytic effect is related to the ease and reversibility of their reduction by sequentially accepting several electrons. The electrochemical properties of heteropolyacids were measured to determine whether it would be feasible to use them as electron transporters in hydrogen generation systems. The behavior of heteropolyacids in an electrolyte solution is found to shift the rise in the cathodic photocurrent curve in the direction of less negative potentials, the reduction of heteropolyacids being easier than the liberation of hydrogen from the water. Applying catalytically active metals to the surface of the silicon shifts the potential at which the reduction of heteropolyacids begins in an illuminated silicon electrode in the direction of positive values. In principle, this makes it possible to increase the photoelectrocatalytic activity of the silicon electrode in relation to the hydrogen photoliberation reaction. Figures 6, references 10: 3 Russian, 7 Western

UDC 621.794:621.373.826

**Laser Etching of Copper in Nitric Acid Solution**

18410018b Moscow ELEKTROKHIMIYA in Russian  
Vol 24 No 7, Jul 88 (manuscript received 11 Mar 87)  
pp 911-915

[Article by Yu. V. Seryanov, V. B. Rabkin, and L. A. Surmenko, Saratov]

[Abstract] A study examined the possibility of stimulating local etching of copper by the thermal effect created by the action of near-infrared band laser radiation. The power of the laser source used in the studies was up to 120 W, and the wavelength was 1.06  $\mu\text{m}$ . The working electrodes were 10x30 mm vacuum-melted copper foil plates 50  $\mu\text{m}$  thick. The surface was degreased with alcohol and passivated with a weak solution of nitric acid. The laser beam was focused to a diameter of 460  $\mu\text{m}$ , which caused local heating and rapid etching of the copper. The time required to etch through the copper foil

was measured. To estimate the effect of laser acceleration, the corrosion rates in electrochemical processes with zero laser radiation power were also measured. The increase in the rate and the diameter of laser etching spots was found to be nonmonotonic as a function of laser power and resulted from bubble and film boiling of the electrolyte. Laser acceleration factors of up to 40 with a resolution equal to about three spot radii were achieved. The laser etching process is limited by anodic dissolution of copper in the nitric acid, but anodic activation of laser etching causes oxidation of the copper surface, which reduces the laser acceleration factor and destructive capability of the process. Figures 4, references 11: 10 Russian, 1 Western.

UDC 541.135.5

**Diffuse Scattering and Electroscattering of Light Near Critical Phase Transition Points at Metal/Electrolyte Boundary**

18410018c Moscow ELEKTROKHIMIYA in Russian  
Vol 24 No 7, Jul 88 (manuscript received 21 Apr 87)  
pp 925-930

[Article by L. I. Daykhin and M. I. Urbakh, Institute of Electrochemistry imeni A. N. Frumkin, USSR Academy of Sciences, Moscow]

[Abstract] It is suggested that the critical behavior at a metal-electrolyte interface be studied by the diffuse scattering and electroscattering of light. Expressions are derived for the intensity of diffuse scattering in the vicinity of critical phase transition points on the surface of a metal electrode. It is shown that at the present level of measurement accuracy optical methods can be used to study the behavior of adsorption layers at the metal-electrolyte interface near the critical points of second-order phase transitions. Figure 1, references 12: 6 Russian, 6 Western.

UDC 541.13:541.141.7:577.3

**Reaction of Chlorophyll With Water During Oxygen Photoevolution Reaction at Octane-Water Interface**

18410330a Moscow ELEKTROKHIMIYA in Russian  
Vol 24, No 3, Mar 88 (manuscript received 4 Aug 86)  
pp 288-294

[Article by M. D. Kandelaki, A. G. Volkov, V. V. Shubin, A. L. Levin (deceased), and L. I. Boguslavskiy, Electrochemistry Institute, Moscow; Applied Molecular Biology and Genetics All-Union Scientific Research Institute, All-Union Academy of Agricultural Sciences imeni V.I. Lenin, Tbilisi; Biochemistry Institute imeni A.N. Bakh, Moscow; Medical Instrument Building All-Union Scientific Research Institute, Moscow]

[Abstract] Photooxidation of water with chlorophyll illuminated with visible light has been observed when the chlorophyll was immobilized on a metal electrode,

on a bilaminar lipid membrane, on aerosol, and at the interface of two immiscible liquids. Despite much work devoted to studying the aggregate state of immobilized chlorophyll and its reaction with the solvent, the form in which chlorophyll participates in the reaction taking place at the octane-water interface remains unclear. It has been observed that, upon illumination of an octane-water interface with visible light and in the presence of chlorophyll, a proton acceptor (dinitrophenol or pentachlorophenol) in the octane, and an electron acceptor in the water, oxygen is evolved from the water. The quantum yield at 660 nm wavelength is about 0.6 percent based on the number of quanta of light falling thereon, and 10 percent is based on the number of absorbed quanta. During a 1-hour exposure, 10,000 molecules of oxygen are evolved per molecule of chlorophyll adsorbed at the octane-water interface. The potential leap, thus generated at the octane-water interface, is directly proportional to the quantity of adsorbed chlorophyll and the rate of oxygen evolution. The oxygen evolution spectrum is similar to the spectrum for the absorption of chlorophyll a in the octane-water system. This article presents a study of the reaction between chlorophyll a dissolved in octane and water. The conditions at which hydrated chlorophyll oligomer is generated at a 742-nm absorption maximum are described. During the photooxidation of water that has been sensitized with chlorophyll adsorbed at the interface, it is necessary to have water present in the octane phase so as to permit autoaccumulation of a catalytic complex, which has yet to be identified. Figures 5; references 32: 13 Russian, 19 Western.

UDC 541.138.2

#### **Protein Protection Effect During Electrochemical Activity on Blood and Other Biological Fluids**

18410330b Moscow ELEKTROKHIMIYA in Russian  
Vol 24, No 3, Mar 88 (manuscript received 9 Oct 86)  
pp 295-299

[Article by Yu. B. Vasilyev, V. A. Grinberg, V. I. Sergiyenko, A. K. Marshynov, T. V. Bulygina, and V. I. Shilov, Electrochemistry Institute, Moscow, Physical Chemistry of Medicine Scientific Research Institute, RSFSR Ministry of Health, Moscow]

[Abstract] It has recently been proposed that the electrochemical oxidation of toxins be used as a method for simulating the detoxification functions of the liver. High hopes have been placed in the polarization of hemosorbents for the purpose of increasing their sorption capacity and selectivity. This rests entirely on the results of research carried out on model solutions and does not take into account the specifics of biological systems. Research on the electrooxidation of various toxins on electrodes in blood, plasma, and lymph as well as research on the effects of the hemosorbent potential on sorption magnitude indicates the existence of a factor that reduces to null all electrochemical actions on the toxin. This factor is the so-called "protein protection

effect", i.e. the binding of the toxin with albumin (which carries out a transport function in the organism) and with other proteins. In an organism the simplest detoxification cycle takes place between two biomolecules—albumin and cytochrome P-450. Albumin fulfills the transport function and cytochrome P-450, the oxidizing function. Hydrophobic matter (RH) entering the organism is bound to albumin (A) and transported in the form of the complex RHA to the liver. There the xenobiotic is oxidized to ROH on cytochrome P-450, which is located in the membranes of the hepatocyte endoplasmatic lattice. The oxidized product subsequently enters other excretory organs and is eliminated from the organism. Most blood toxins are bound with albumin, i.e. RHA complexes, whose adsorption and electrochemical properties may differ markedly from the toxins in simulated protein-free solutions. For this reason, in this work a study was made of the effect of albumin on the electrooxidation of typical toxins on a platinum electrode and on their sorption on a polarized carbon sorbent. Bilirubin and cholesterol were chosen as typical endogenous toxins and hexenal as a typical xenobiotic since the latter is frequently encountered in clinical practice. It was demonstrated that binding the toxin in blood with albumin into a strong complex severely inhibits elimination of the toxin from blood and other biological fluids when using various physicochemical methods, including direct electrochemical oxidation or adsorption on polarized or nonpolarized sorbents. Therefore, not taking into account the specifics of biological systems could lead to undue optimism in evaluating the prospects of using electrochemical actions on blood for the purpose of detoxification. Binding a blood toxin with albumin into a strong complex inhibits its elimination. Figures 6; references 17: 12 Russian, 5 Western.

UDC 541.183

#### **Adsorption and Electrochemical Behavior of Barbituric Acid on Carbonaceous Materials**

18410330c Moscow ELEKTROKHIMIYA in Russian  
Vol 24, No 3, Mar 88 (manuscript received 10 Oct 86)  
pp 300-303

[Article by V. N. Andreyev, V. A. Bogdanovskaya, M. M. Goldin and M. M. Fabina, Electrochemistry Institute, Moscow]

[Abstract] Barbituric acid is a condensation product of such physiologically active compounds as urea and malonic acid, and many important and useful barbiturates such as medinal, barbital, phenobarbital, barbamil, and others with various substituents have been prepared from this acid. Uric acid, which is physiologically important, is also synthesized through barbituric acid. It is important that uric acid's physicochemical properties be studied and compared with those of its derivatives to determine the effects of various substituents on the properties of this class of compounds. The electrochemical behavior of barbituric acid on mercury, platinum, and carbonaceous materials has been studied. Thus, on a



mercury electrode, it is adsorbed on the surface, which causes passivation of the latter. On a smooth platinum electrode, on the other hand, radical particles are formed that are subsequently dimerized; the acid becomes decomposed through anode oxidation on a platinized platinum electrode. Electrooxidation was observed on carbonaceous materials at potentials more positive than 1.6 volts to form dimers and chlorine products if the solution contains chlorine ions. A study of the electrochemical behavior of barbituric acid derivatives on carbonaceous materials showed that the pH of the solution and the structure of the barbiturate have a significant effect on adsorption and the capability to engage in redox reactions. A study of the electrooxidation of uric acid on pyrolytic carbon suggests that an unstable five-membered intermediate product is formed that subsequently decomposes. It thus appears that all of the observed compounds are subject to electrochemical oxidation, where the potential for oxidation initiation is a function of the nature of the electrode material, the pH of the solution, and the structure of the compound. In the present work a study was made of the adsorption and electrochemical reactions of barbituric acid on various electrodes and pH values. It has been demonstrated that the acid is adsorbed irreversibly and that the magnitude of the latter depends on the pH of the solution and the nature of the carbonaceous material. Barbituric acid fails to become oxidized or reduced within the studied interval of plus 1.3 to minus 0.1 volts. The results suggest that a correlation exists between the physiological and electrochemical activities. Thus, medial, barbital, barbimyl, and phenobarbital are physiologically active and are electrochemically oxidized and reduced, while barbituric acid is both physiologically and electrochemically inactive. Figures 4; references 10: 5 Russian, 5 Western.

UDC 541.135.5

**Hydroelectrochemical Impedance Associated With Turbulent Pulsations of Electrolyte Solution**

18410330d Moscow ELEKTROKHIMIYA in Russian  
Vol 24, No 3, Mar 88 (manuscript received 14 Nov 86)  
pp 373-376

[Article by S. A. Marmetyanov and B. M. Grafov,  
Electrochemistry Institute, Moscow]

[Abstract] A great deal of research has been done on the current pulsations of electrochemical reactions associated with turbulent pulsations in the hydrodynamic velocity of the electrolyte, wherein the pulsations of the limiting current of diffusion is normally studied. It seemed interesting to clarify the effects of the parameters of the electrode process on the characteristics of the turbulent pulsations in the current passing through the

cell (in the potentiostatic mode) or the potential at the terminals of the electrochemical chain (in the galvanostatic mode). In the present work the hydroelectrochemical impedance of a stationary flat electrode, associated with turbulent pulsations of the hydrodynamic velocity of the electrolyte, was derived mathematically for conditions of a reversible electrochemical system having uniform electrode surface availability and no adsorption. References 7: 3 Russian, 4 Western.

UDC 541.133-165

**Solid Electrolytes Having Rubidium-Cationic Conductivity in System  $\text{Ga}_2\text{O}_3\text{-TiO}_2\text{-Rb}_2\text{O}$**

18410330e Moscow ELEKTROKHIMIYA in Russian  
Vol 24, No 3, Mar 88 (manuscript received 4 Feb 87)  
pp 383-385

[Article by Ye. I. Burmakin and G. Sh. Shekhtman,  
Electrochemistry Institute, Sverdlovsk]

[Abstract] It has been shown previously that within systems of the type  $\text{Ga}_2\text{O}_3\text{-EO}_2\text{-K}_2\text{O}$  (where E is a tetravalent element) it is possible to obtain solid electrolytes having high potassium-cationic conductivity in the form of solid solutions based on potassium monogallate. Since the structures of  $\text{RbGaO}_2$  and  $\text{KGaO}_2$  are very similar, it seemed interesting to investigate analogous rubidium-containing systems. In the present work a study was made of two cuts of the title system having a  $\text{Ga}_2\text{O}_3$  to  $\text{Rb}_2\text{O}$  ratio of 1/1 (a) and 1.5/2 (b). The methodology and equipment are described elsewhere. Samples were calcined at 900-1,000°C. X-ray analysis indicated that the orthorhombic structure of the rubidium monogallate is lost in both cuts. Introducing titanium dioxide results in the formation of a face-centered cubic lattice in the solid solution and isostructural high-temperature  $\gamma$ -modifications in  $\text{KFeO}_2$ . Specific resistance isotherms show that introduction of titanium dioxide to rubidium monogallate results in a marked drop in resistance. Specific resistance minima for both cuts correspond to that of the single-phase region of cubic solid solutions similar to  $\gamma\text{-KFeO}_2$ . Solid electrolytes in this region have a very high specific resistance (70-80 Ohm-cm at 400°C.) and a very high activation energy of conductivity (30-35 kilojoules per mole). Curves of the log of specific resistance plotted against the reciprocal temperature have an inflection point that exactly coincides with the thermal effect point on differential thermal analysis curves. The activation energy of the conductivity of pure  $\text{RbGaO}_2$  in the high temperature region is much lower than in the low temperature region. For compositions containing titanium dioxide, this inflection point is missing. Similar manifestations were displayed with solid electrolytes of cut (b). Figures 3; references 10: 8 Russian, 2 Western.

UDC 631.95

**Ecological Effects of Intensification of Agriculture**  
*18410039F Moscow AGROKHIMIYA in Russian*  
*No 8, Aug 88 pp 125-129*

[Article by A. Yu. Kudeyarova and V. I. Nikitishen]

[Abstract] An international symposium held in Yambol, Bulgaria, 9-14 Nov 1987 as a part of the "Man and the Biosphere" program was devoted to the ecological effects of the intensification of agriculture. The purpose of the symposium was to collect, discuss, and disseminate information on the state of the environment as related to agricultural production and to generate suggestions to prevent environmental pollution. Topics discussed included the balance of nutrient substances in Bulgaria; the influence of sprinkler irrigation on the loss of nutrient substances from fertilized soil; the influence of mineral fertilizers on the accumulation of nitrides in cabbage; the relationship between nitrogen dose and phosphorus content of the soil; the acidifying effect of nitrogen fertilizer; ecological problems related to the use of phosphorus fertilizers; the influence of various types of fertilizers on the chemical composition of plants; ecological problems in the use of industrial wastes in agriculture; the interactions of microorganisms and pesticides in the soil; the inhibiting effect of certain herbicides on soil nitrification; zinc contamination of the soil and its influence on physiological processes in plants; the content of arsenic, cadmium, and lead in the soils of various nations and resultant physiological and biochemical changes in plants; the content of nitrogen in

surface run-off; sprinkler irrigation and erosion; qualitative changes in humus accompanying agricultural utilization of soils; and the problem of contamination of agricultural areas with animal husbandry waste products. A resolution was adopted that called for the development of a range of measures to reduce the negative ecological effects of intensive agriculture.

UDC 628.3.543.33

**Determining Calcium and Magnesium in Highly Colored Wastewater by Process of Boiling Cotton Lint**  
*18410044d Tashkent UZBEKSKIY KHIMICHESKIY*  
*ZHURNAL in Russian No 4, Jul-Aug 88 pp 16-18*

[Article by S. M. Shamsiyev and G. M. Musayeva, Tashkent Department, All Union Water Supply, Wastewater Disposal, Water Development Works, and Engineering Hydrogeology All-Union Scientific Research Institute]

[Abstract] This article presents a method of determining calcium and magnesium in wastewaters from the process of boiling cotton lint. The method entails the preliminary oxidation of dyed organic substances with sodium persulfate in a sulfuric acid medium, followed by complexometric titration. The conditions under which the waters are decolorized and the course of the analysis of the calcium and magnesium are described. The method was tested on wastewaters and standard solutions, and it was found to be suitable for determining calcium and magnesium in wastewaters from boiling of cotton lint regardless of type and contamination. References 5: Russian.



UDC 631.811:631.582(477.7)

**Nutrients Balance in Specialized Crop Rotation in Southern Ukraine Steppes**

18410003b Moscow AGROKHIMIYA in Russian No 6  
Jun 88 (manuscript received 7 Apr 87) pp 45-49

[Article by N. N. Popov, L. G. Khonenko, and M. M. Popova, Nikolayev Scientific Production Association Elita]

[Abstract] Nutrient balance is one of the most important indicators of man's interaction with soil. It has been found that achieving bumper harvests does not always require making a full return of soil nutrients with fertilizers. Field tests conducted from 1979 to 1984 at the Nikolayev Oblast Agricultural Experimental Station with specialized 10-plot crop rotations show that field structure and crop rotation both influence the uptake of nutrients by the plants. By adding 52, 42, and 33 kg per hectare of nitrogen, phosphorus, and potassium, respectively, under nonirrigated conditions of the southern Ukraine steppe, the nitrogen and potassium balance became negative, while that of phosphorus became positive, regardless of field structure. Maximum nutrient uptake was observed in cereal crop rotations: nitrogen, 63 percent; potassium, 73 percent; and phosphorus, 28 percent. These figures were lowered to 25, 58, and 7 percent, respectively, with 20 percent crop rotation with sunflowers. References 5 (Russian).

UDC 631.811:633.13

**Utilization of Soil and Fertilizer Nutrients by Oats as Related to Dose and Ratio**

18410003c Moscow AGROKHIMIYA in Russian No 6  
Jun 88 (manuscript received 5 Mar 87) pp 50-56

[Article by P. I. Vitrikhovskiy, G. I. Osadchiy, N. N. Koretskaya, and O. P. Bedratyuk, Ukrainian Farming Scientific Research Institute, Chabany, Kiev Oblast]

[Abstract] Clarification of the interaction of nutrient elements in the system fertilizer-soil-plant is one of the most important steps in the rational use of fertilizers. Numerous experiments with tracer isotopes have demonstrated the positive effects of nitrogen or nitrogen and potassium on the assimilation of fertilizer phosphorus by plants. By increasing the dosage of the latter, the coefficient of utilization of fertilizer phosphorus is decreased. Depending on the conditions under which the fertilizer is applied, the utilization factor for phosphorus varies from 2 to 40 percent, whereas that for nitrogen ranges from 5 to 70 percent. The remainder of the nitrogen in the fertilizer is lost through volatilization to the air or through various forms of denitrification and washout with precipitation, as well as through fixation by microorganisms and irreversible absorption by the soil. When high doses of phosphorus are applied to plants in conjunction with ammoniacal nitrogen, the latter enters the

plant in excess and may cause a depression in its development. Most experiments have been conducted on a small scale, which fails to give a full picture of the interaction of fertilizer nutrients over a wide range of dosage and ratio variations. Vegetational experiments on oats were conducted in 1976-80 in vessels containing 5.6 kg of soddy podzolic clayey-sandy soil using N-15, P-32, and Rb-86 tracers to clarify the interaction of basic nutrient elements with their utilization and productivity of the plants. The introduction of growth dosages of potassium and phosphorus resulted in lowering the coefficient of utilization of phosphorus from 20 to 16 percent, while introduction of nitrogen against this same background raised productivity 4-5 times and doubled the coefficient of utilization of phosphorus. Increasing the nitrogen dosage considerably had no effect on its assimilation. By improving phosphorus nutrition, the coefficient of utilization of nitrogen grew from 45-52 percent to 55-62 percent, and its losses dropped from 25-39 percent to 17-29 percent. Figure 1; references 16 (Russian).

UDC 631.84:633.16

**Influence of Phosphate-Coated Carbamide on Grain Harvest**

18410039a Moscow AGROKHIMIYA in Russian  
No 8, Aug 88 (manuscript received 22 Sep 87) pp 8-14

[Article by I. A. Yushkevich, G. V. Pirogovskaya, Ye.I. Shagiyeva, S. V. Plyshevskiy, and S.I. Kuleshova, Belorussian Soil Science and Agrochemistry Scientific Research Institute, Minsk; Belorussian Institute of Technology, Minsk]

[Abstract] A study examined the influence of carbamide coated with a phosphate shell on the harvest of barley. The nutrient substance utilization factor and losses of nutrients upon infiltration of precipitation were also examined. Studies were performed in vegetation and field experiments in 1981-1985 on podzolic loam soil with a  $pH_{sol}$  of 5.3, a  $K_2O$  content of 6.9 mg, and a  $P_2O_5$  content of 20.3 mg/100 g soil. Podzolic sandy soil with a  $pH_{sol}$  of 5.5, a  $K_2O$  content of 9.5 mg, and a  $P_2O_5$  content of 10.9 mg/100 g soil was also studied. The retardation of carbamide action was found to result from the composition and mass of the coating. It had a significant influence on the harvest. The most effective fertilizer in both loam and sandy soils had a nitrogen liberation delay factor of 1.8-2.0. Carbamide protected by shells based on calcium hydrophosphate, when used in a mixture of phosphorus-potassium fertilizers, increased the barley harvest in vegetation experiments by 8-32 percent and in field experiments by 10-14 percent. The nitrogen utilization factor was increased by 5.9-7.8 percent, phosphorus utilization increased by 3.2-3.4 percent, and potassium utilization increased by 1.0-4.6 percent. At the same time, nitrogen losses were reduced by 3.1-5.8 percent, and potassium losses were reduced by 1.6-10.8 percent. References 23: Russian.

UDC 657.62:631.811.1

**Nitrogen Fertilizer Balance in Soil-Plant System With Intensive Use of Grasses (<sup>15</sup>N Studies)**

18410039b Moscow AGROKHIMIYA in Russian  
No 8 Aug 88 (manuscript received 18 Jul 87) pp 15-19

[Article by I. I. Isekeyev, Yamalskaya Agricultural Experimental Station; Agriculture of the Northern Transurals Scientific Research Institute, Salekhyard]

[Abstract] Studies were done in 1981-1982 on an experimental field in the northern Transurals to determine the fertilizer nitrogen utilization factor in soddy podzolic soil with surface and root improvement of grasses. The nitrogen utilization factor as determined by the use of labeled <sup>15</sup>N was 45-51 percent when the grasses were cut three times per season. The application of lime increased the nitrogen utilization factor by 3-4 percent. Increasing the dose of applied nitrogen from 60 to 120 kg/ha increased nitrogen losses from 38-44 percent to 44-53 percent. References 8: Russian.

UDC 631.85:631.445.5:631.445.51:631.445.56

**Effectiveness and Assimilation of Ammonium Polyphosphate Fertilizer From Karatau Phosphorites in Carbonaceous Soils**

18410039c Moscow AGROKHIMIYA in Russian  
No 8, Aug 88 (manuscript received 27 Jul 87) pp 20-30

[Article by F. V. Yanishevskiy, V. A. Kozhemyachko, G. V. Polyakova, and A. A. Brodskiy, Fertilizers and Insectofungicides Scientific Research Institute imeni Ya. V. Samoylov; Ministry of Fertilizers Scientific-Production Association, Moscow]

[Abstract] Dehydration of ammonium orthophosphates in gaseous ammonia has been used to produce a new ammonium polyphosphate product called poliammofos (PAF). PAF is manufactured by neutralizing phosphoric acid with gaseous ammonia; evaporating the ammonium phosphate slurry; and granulating, drying, and roasting of the product. This article presents the results of a study of the agrochemical effectiveness of PAF from Karatau phosphorites in vegetation experiments on serozem, chestnut, and chernozem soils with a high carbonate content (3-9 percent CO<sub>2</sub>). PAF was found to be superior to ammofos under these conditions and equal in soils containing 0.4-0.9 percent CO<sub>2</sub>. Phosphorus is assimilated better under high-carbonate conditions from PAF than from ammofos. PAF has increased solubility of the water-insoluble P<sub>2</sub>O<sub>5</sub> and forms more mobile P<sub>2</sub>O<sub>5</sub> in the soil, which is better assimilated by the plants. PAF is less reactive with carbonates, thus facilitating retention of organic matter in the soil. Figures 3, references 44: Russian.

UDC 631.871:633.511

**Influence of New Organic Fertilizers (R-S AFU and R-S) on Properties of Soil Used To Grow Cotton**

18410039d Moscow AGROKHIMIYA in Russian  
No 8, Aug 88 (manuscript received 21 Oct 87) pp 70-75

[Article by A. R. Akhmelov, Azerbaijan State University, Baku]

[Abstract] New types of fertilizer for the cotton fields of Azerbaijan must have acid properties to decrease the soil's alkalinity, facilitate decomposition of complex compounds, and increase the mobility of bi- and trivalent cations, thereby stimulating the formation of complex organomineral humus compounds and improving mineral plant nutrition conditions. Treating cotton wastes with the acid wastes from oil refineries yields sulfur-containing organic fertilizer (R-S) that contains various functional groups. Field experiments have shown that applying R-S delays the drop in humus content of the soil beginning in the very first year. To increase the synthesis of humus, diatomic phenol and nitrogen were introduced, thus yielding a new product (R-S AFU), which is an organic fertilizer containing nitrogen, sulfur, and phenol. Field experiments were conducted from 1974 to 1978 with the new fertilizers. They were found not only to prevent humus loss but also to cause its accumulation in cotton monocultures while improving a number of other soil properties including aggregate composition, physical properties, and biological activity. References 15: Russian.

UDC 541.8:541.123.6:631.8

**Solubility Polytherm of System Monoammonium Phosphate—Malonic Acid—Water**

18410044b Tashkent UZBEKSKIY KHIMICHESKIY ZHURNAL in Russian No 4 Jul-Aug 88 (manuscript received 26 Feb 88) pp 12-13

[Article by S. Tukhtayev, A. Kh. Narkhodzhayev, and F. S. Askarova, Institute of Chemistry, UzSSR Academy of Sciences]

[Abstract] A study examined the behavior of monoammonium phosphate and malonic acid when they are simultaneously present over a broad range of concentrations and temperatures. The solubility polytherm of the system monoammonium phosphate—malonic acid—water was studied by means of nine internal cross sections. Formation of new chemical compounds in the system was not detected in the temperature interval studied. It is a simple eutonic system. As the malonic acid concentration increases, the solubility of monoammonium phosphate decreases very little. Increasing the monoammonium phosphate content decreases the concentration of malonic acid. Figure 1, references 5: Russian.

UDC 633.11

**Solubility Polytherm of System Carbamide—  
4-Amino-1,2,4-Triazole—Water**

18410044c Tashkent UZBEKSKIY KHIMICHESKIY  
ZHURNAL in Russian No 4 Jul-Aug 88 (manuscript  
received 29 Dec 87) pp 14-16

[Article by Yu. I. Dergunov, V. G. Vodopyanov, A. T.  
Dadakhodzhaev, and P. T. Yunusova, Tashkent Order  
of Friendship of Peoples Polytechnical Institute imeni  
Abu Raykhana Beruni]

[Abstract] The solubility of phases in the system carbamide—4-amino-1,2,4—triazole—water was studied by a visual polythermic method. The eutectic in the system corresponds to 32 percent  $\text{CO}(\text{NH}_2)_2$  at  $-11.6^\circ\text{C}$ . The solubility in the binary system was studied for the first time. The eutectic point of the system was 64 percent 4-amino-1,2,4—triazole at  $-31^\circ\text{C}$ . The 4-amino-1,2,4—triazole—carbamide diagram, the third side of the concentration triangle, has two eutectic points, 16 percent  $\text{CO}(\text{NH}_2)_2$  at  $67.6^\circ\text{C}$  and 40 percent  $\text{CO}(\text{NH}_2)_2$  at  $69.4^\circ\text{C}$ . Figure 1, references 3: Russian.

UDC 621.373.826-181.4

**Spectral-Luminescent Properties of Neodymium in Alkali Phosphate Glasses**

18410001a Leningrad FIZIKA I KHIMIYA STEKLA  
in Russian Vol 14 No 3, May-Jun 88 (manuscript  
received 26 Feb 87) pp 349-354

[Article by V. A. Komolova, S. G. Lunter, A. G. Plyukhin, M. N. Tolstoy, and Yu. K. Fedorov]

[Abstract] The present work was undertaken for the purpose of establishing the spectral-luminescent features of alkali lanthanum phosphate neodymium glasses and comparing the properties of previously studied nonalkali and lithium lanthanum phosphate glasses. A study was made of the following ultraphosphate glasses (in molecular percent):  $20\text{Me}_2\text{O}[\text{bn}]10(\text{La}_2\text{O}_3 + \text{Nd}_2\text{O}_3)[\text{bn}]70\text{P}_2\text{O}_5$ , where Me is Li, Na, K, Rb, or Cs. The neodymium concentration varied from 1 to  $14 \times 10^{20} \text{ cm}^{-3}$ . The results showed that the probability of neodymium luminescence extinction in  $\text{Me}^+$  (La, Nd) ultraphosphate glasses varies linearly with the activator concentration both in the cross-relaxation scheme and hydroxyl group vibrations and that due to the latter exceeds that of the former within the concentration range studied. The probability of neodymium luminescence extinction in the cross-relaxation scheme increases with the field strength of the alkali cation in the series Cs-Li, whereas that in the hydroxyl group vibrations scheme decreases from Cs to K (La, Nd) ultraphosphate glasses. The half-width of the neodymium luminescence line in  $\text{Me}^+$  (La, Nd) ultraphosphate glasses is linearly dependent on the ionic radius of the alkali metal cation and decreases in transition from lithium to cesium ultraphosphates. Figures 4; references 15: 14 Russian, 1 Western.

UDC 539.213

**Glass Formation and Critical Cooling Rates in System As-Ge-Te**

18410001b Leningrad FIZIKA I KHIMIYA STEKLA  
in Russian Vol 14 No 3, May-Jun 88 (manuscript  
received 23 Apr 87) pp 377-380

[Article by M. D. Mikhaylov, A. S. Tveryanovich, and V. N. Yadryshnikova, Leningrad State University imeni A. A. Zhdanov]

[Abstract] The possibility of obtaining a substance in the glassified state by supercooling a melt depends on the interrelationship of several fundamental characteristics of the substance and the experimental conditions, especially the rate at which the melt cools. Therefore, the so-called critical cooling rate, i.e., the minimum cooling rate at which most of the substance can be obtained in the glassified state, becomes a natural choice for this purpose. In the present work critical cooling rates were measured for the three-component system As-Ge-Te. Forty-eight melts were prepared with compositions

within the glassification range according to published data, and critical cooling rates were determined by differential thermal analysis or by volumetric methods, depending on the crystallization capability of the melt. Three regions of maximum glass-forming capability were determined. It was observed that the critical cooling rate of composition  $\text{AsTeGe}_{0.2}$  is one whole order of magnitude greater than the critical heating rate of the glass. Figures 2; references 15: 10 Russian, 5 Western.

UDC 666.113.32

**Electrical and Thermal Properties of Silver-Containing Glasses of System Ge-Sb-Se**

18410001c Leningrad FIZIKA I KHIMIYA STEKLA  
in Russian Vol 14 No 3, May-Jun 88 (manuscript  
received 8 Jul 87) pp 418-422

[Article by V. A. Kochemirovskiy and Ye. A. Bychkov, Leningrad State University imeni A. A. Zhdanov]

[Abstract] Traces of transition metals in chalcogenides result in considerably improved electrical conductivity. These metals may be divided into two groups according to the degree of their effect on conductivity. The first group includes metals having unfilled d-shells, such as iron, nickel, and cobalt, which increase the conductivity of glasses by 3-4 orders of magnitude at concentrations of 0.5-2.0 atomic percent. These additives are distinct in that they reside in the glass in two states of oxidation (di- and trivalent). The other group consists of elements having a stable electron configuration in the 3d-shell such as copper and manganese, which have a somewhat lesser electrical activity. These metals reside in glass in a single charge state. The second group also includes silver, which resembles copper in its electrical activity and glass-forming capability. Chalcogenide glasses containing silver are interesting because small traces of the latter increase electron-hole transfer, whereas conversion to ionic conductivity takes place in silver in sulfide and selenide binary melts at 6-8 atomic percent binary concentrations. Also, chalcogenide glasses containing silver are promising membrane materials for ion-selective electrodes. The present work examines the effects of adding silver on the physical chemical properties of the three-component system Ge-Sb-Se and shows that the presence of silver has a greater effect on its electrical properties than does copper or manganese. This is evidently due to the ionogenic nature of the silver additive. Figures 2; references 15: 9 Russian, 6 Western.

UDC 666.113

**Study of Vaporization of Certain Borosilicate Glasses by High Temperature Mass Spectrometry**

18410001d Leningrad FIZIKA I KHIMIYA STEKLA  
in Russian Vol 14 No 3, May-Jun 88 (manuscript  
received 3 Jul 87) pp 440-444

[Article by I. Yu. Archakov and V. L. Stolyarova, Silicate Chemistry Institute imeni I. V. Grebenshchikova, Leningrad]

[Abstract] Borosilicate glasses are used in many branches of modern technology, and special care must be exercised when synthesizing them or when using them at

temperatures exceeding 1,200 K owing to possible changes in their properties resulting from vaporization processes. These glasses are currently being used as matrices for immobilizing highly active nuclear wastes stored underground. They may be prepared by melting an aqueous hydroxide slurry of radioactive and glass-forming elements at 1,420 K. Glasses based on the system  $B_2O_3-SiO_2$  are used as sensors in ion-selective field transistors. The addition of aluminum oxide to borosilicate glasses prevents deglassification and increases chemical resistance. High-melting and solar resistant glasses such as these are used in mercury lamps. Airtight metal-to-glass seals are especially useful in the Pyrex glass and steel tubing used in solar collectors. Welding with borosilicate glass has been proposed for making glass joints with aluminum and beryllium oxide ceramics as in fabricating electron beam tubes. A glass developed at the Silicate Chemistry Institute, IKhS-10, is used in electron-vacuum and electronic component building such as for an airtight coatings during isostatic pressing of ceramics. Since glass IKhS-10 meets the requirements needed for casing material for pressed ferrite components at temperatures of 1,170- 1,470 K, a study was made of the vaporization of the components of this glass as compared with industrial Pyrex glass. Knudsen's effusion method of mass spectrometry showed that at these temperatures the vapor over the IKhS-10 glass contains  $LiBO_2$  and  $NaBO_2$ , while that over Pyrex glass contains  $NaBO_2$  and  $KBO_2$ . Temperature-vapor pressure curves for  $NaBO_2$  were also determined for the glasses. Figure 1; references 23: 9 Russian, 14 Western.

UDC 666.1.036.5:539.213.1:541.1

**Role of Oxides in Structure Formation of Magnesia-Alumina Silicate Glass Fibers Containing  $TiO_2$**

18410001e Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 3, May-Jun 88 (manuscript received 24 Mar 87) pp 463-467

[Article by G. L. Tyshkovskiy, L. A. Sapozhkova, V. I. Fertikov, N. K. Vikulova, and V. D. Musiyachenko, Glass Fibers and Reinforced Plastics Scientific Research Institute, Moscow]

[Abstract] Developing materials having predetermined properties requires having a clear understanding of the interrelationships between composition, structure, and properties. These must be established for glass fibers since it is widely known that even slight changes in composition could lead to a change in properties and data on the structural characteristics of glass fibers are very limited. In the present work a study was made of the effects of various components of magnesia-alumina silicate glass fibers on the energy of the element-oxygen bond, the coordination state of the elements, crystallization resistance, and strength. Three previously studied magnesia-alumina silicate glass fibers having diameters of 9  $\mu m$  and 0.5 and 2.0 percent titanium dioxide added were investigated. X-ray fluorescence, x-ray phase analysis, and IR spectroscopy

revealed structural differences in the magnesia-alumina silicate glass fibers. The  $Al^{+3}$  ion was found to exist basically in the tetrahedral state and to a lesser extent as the highly coordinated ion. The coordination number of the  $Mg^{plus2}$  ion remains constant at 6, regardless of the  $MgO$  concentration. Raising the concentration of titanium dioxide from 0.5 to 2 percent results in greater crystallization capability and deterioration of the glass fiber's physical and mechanical properties. Figure 1; references 13: 11 Russian, 2 Western.

UDC 546.22.41.86

**Preparation and Study of Triple Compounds  $CaSb_2S_4$ ,  $Ca_2Sb_2S_5$ , and  $CaSb_4S_7$**

18410008a Ivanovo IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: KHIMIYA I KHIMICHESKAYA TEKHOLOGIYA in Russian Vol 31 No 6, Jun 88 (manuscript received 16 Apr 87) pp 20-23

[Article by T. N. Guliyev, P. G. Rustamov, and M. I. Chiragov, Azerbaydzhan State University imeni S. M. Kirov]

[Abstract] In a previous work the compound  $Ca_2Sb_2S_5$  was prepared for the first time and its crystal lattice parameters determined. In the present work polycrystalline samples of the system  $CaS-Sb_2S_5$  were prepared and found to contain the title compounds. The first two compounds were obtained as single crystals, and their lattice parameters were determined. The second and third are incongruent compounds that decompose at 993 and 923 K, respectively. Conditions for preparing single crystals of  $CaSb_2S_4$  and  $CaSb_2S_5$  have been worked out and are presented. Figure 1; references 7: 5 Russian, 2 Western.

UDC 666.113.32

**Glass Formation in System Lead Iodide-Silver Sulfide-Arsenic Sulfide**

18410053c Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 4 Jul-Aug 88 (manuscript received 21 Apr 86) pp 508-513

[Article by A. V. Legin, Ye. A. Bychkov, and Yu. G. Yalasov, Leningrad State University imeni A. A. Zhdanov]

[Abstract] A study examined glasses in the system  $PbI_2-Ag_2S-As_2S_3$ , synthesized from an  $As_2S_3$  master compound. The corresponding quantities of silver sulfide and lead iodide were added by the method of vacuum melting in quartz ampules at 0.01-0.1 Pa by heating to 700-720°C for 4-5 hours, holding at that temperature 4-5 hours, and then cooling in air. The vitreous state and homogeneity were checked visually at 490 X magnification and by microstructural analysis. It was found that



up to 70 mol. percent lead iodide can be added to the glass over a broad range of silver and arsenic sulfide concentrations. Extrapolation of the concentration relationships to the hypothetical vitreous lead iodide indicates varying interaction of the components and local environment in the pseudobinary melts  $\text{PbI}_2\text{—As}_2\text{S}_3$  and glasses containing silver. The introduction of lead iodide causes a decrease in glass-formation temperature and a decrease in the crystallization capacity of glasses in the system studied. Figures 4, references 14: 7 Russian, 7 Western.

UDC 541.1.666.14.71.413

**Thermal Expansion and Elastic Properties of Vitreous  $\text{CdGeAs}_2$**

18410053e Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 4 Jul-Aug 88 (manuscript received 3 Aug 86) pp 543-546

[Article by S. B. Rozenkov, A. M. Bolotov, Ye. A. Bychkov, and Yu. G. Vlasov, Leningrad State University imeni A. A. Zhdanov]

[Abstract] A study examined the glass formation process, the composition of the crystalline phases, and the thermal properties of glasses in the system  $\text{CuI—Cu}_2\text{Se—As}_2\text{Se}_3$ . The glasses were synthesized by vacuum melting in quartz ampules at not over 0.1 Pa. The ampules were heated to 300-400°C for 3-4 hours and then to 800°C for 8-10 hours, after which the components were quenched with vibration agitation, and the melt was cooled in water at a rate of about 200°C/s in thin quartz ampules. The Debye temperature was found to be 185 K, the mean-square dynamic atomic displacement was 0.21 Å, and the Grüneisen parameter was 0.73, which indicated an increase in aharmonic atomic oscillation and a decrease in the strength and rigidity of the interatomic bonds in vitreous  $\text{CdGeAs}_2$  as compared with its crystalline modification. References 17: 13 Russian, 4 Western.

UDC 535.377:161.6

**Thermoluminescence of -Irradiated Phosphate Glasses**

18410053f Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 4 Jul-Aug 88 (manuscript received 16 Jul 87) pp 564-570

[Article by S. A. Postelnikov, Institute of Biophysics, Moscow]

[Abstract] Glasses with various hole acceptors similar to  $\text{Mn}^{2+}$  ions were synthesized to verify the suggestion that thermoluminescence arises upon recombination of a thermally delocalized electron at an  $\text{Mn}^{2+(+)}$  center created by the capture of a hole by an  $\text{Mn}^{2+}$  ion. Studies were performed on barium metaphosphate glass synthesized under neutral conditions in quartz crucibles. The behavior of radiation defects in  $\text{PbO—Al}_2\text{O}_3\text{—P}_2\text{O}_5$ :

$\text{MnO}_2$  glasses is studied, and these defects are compared with similar defects in glasses containing other modifiers. It is found that the traditional thermoluminescence mechanism, which assumes recombination of thermally delocalized electrons, is not correct in this case. It is suggested that the high effectiveness of thermoluminescence in manganese-activated phosphate glasses is related to the thermally stimulated diffusion of the  $\text{Mn}^{2+(+)}$  centers to  $\text{Po}_3^{2-}$  radicals. Figures 3, references 14: 8 Russian, 6 Western.

UDC 535.323:539.219.3:666.112

**Influence of Diffusion Stresses on Optical Properties of Layers of Borosilicate Glasses Produced by Low-Temperature Ion Exchange**

$\text{Na}^+_{\text{glass}}\text{—K}^+_{\text{melt}}$   
18410053g Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 4 Jul-Aug 88 (manuscript received 11 Jun 87) pp 571-577

[Article by L. B. Glebov, S. K. Yevstropev, and G. T. Petrovskiy]

[Abstract] A study examined the mechanisms of formation of the optical properties in layers of borosilicate glasses formed by low-temperature ion exchange  $\text{Na}^+_{\text{glass}}\text{—K}^+_{\text{melt}}$  as a function of chemical composition and structure. Studies were performed on glasses in the series  $20 \text{ Na}_2\text{O—x B}_2\text{O}_3\text{—}(80\text{—x})\text{SiO}_2$ . Ion exchange was performed by placing flat polished specimens 3-4 mm thick in a  $\text{KNO}_3$  melt at 350-500°C for 0.1-9 hours. In glasses with a low oxygen number, i.e.,  $\text{Na}_2\text{O/B}_2\text{O}_3 < 1$ , significant microstresses are created. They prevent the free expansion of the ion-exchange layer and cause isotropic increases in the index of refraction. As the oxygen number increases, the framework of the glass breaks down, thus decreasing the microstresses, and the ion-exchange layer expands relatively easily upon ion exchange. The anisotropic increase plays a greater role in the overall increase in the refraction index. Figures 4, references 19: 15 Russian, 4 Western.

UDC 666.11.01

**Optical and Physicochemical Properties of Alkaline Tungsten-Tellurite Glass Upon Mutual Substitution of One Alkaline Component for Another**

18410053h Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 14 No 4 Jul-Aug 88 (manuscript received 4 Sep 87) pp 595-599

[Article by Ye. A. Myasnikova, A. K. Yakhkind, E. P. Maksimova, and E. E. Pugerol]

[Abstract] A study examined the glass formation process in the ternary system  $\text{Li}_2\text{O—WO}_3\text{—TeO}_2$ . The study also included an examination of the crystallization capacity, optical and physicochemical properties, and the structural specifics of tungsten-tellurite glasses as a basis for

the manufacture of glasses with a regular distribution of the index of refraction. Glasses were prepared in a furnace with carborundum heaters in gold crucibles. The glasses were chemically analyzed, their density was determined by hydrostatic weighing in toluene, and their thermal expansion and index of refraction were measured. It was found that when  $\text{Li}_2\text{O}$  is replaced by other alkaline oxides the properties of the tungsten-tellurite glass change according to the position of the elements in the periodic table. Equations are derived that can be used to calculate the index of refraction as  $\text{Li}_2\text{O}$  is replaced by  $\text{Na}_2\text{O}$  or  $\text{K}_2\text{O}$  with an accuracy equal to experimental determination. Introduction of  $\text{WO}_3$  yields structures transitional between chain and trigonally linked polyhedrons. The increase in  $R_k$  as  $\text{Li}_2\text{O}$  is replaced by oxides of heavier alkali metals is determined by the change in polarizability of the  $\text{Me}^+$  bond with the glass framework. Figures 3, references 8: Russian.

UDC 621.315.592

**Change in Forbidden Zone Width on Surface of  $\text{Cd}_{1-x}\text{Mg}_x\text{Te}$  Single Crystals Under Laser Radiation**

18410335b Moscow *POVERKHNOT: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 3, Mar 88 (manuscript received 12 Jun 87) pp 91-95

[Article by V. V. Artamonov, A. Baydullayeva, P. Ye. Mozol and V. V. Strelchuk, Semiconductor Institute, Kiev]

[Abstract] Significant changes in physical properties are observed during single-pulse laser irradiation (duration,  $10^{-8}$  seconds) of various crystals of type  $\text{A}^{\text{II}}\text{B}^{\text{VI}}$ . Equilibrium conductivity, stationary photocurrent, and the intensity of exciton and doped photoluminescence are among the properties altered. In crystals of  $\text{Zn}_x\text{Cd}_{1-x}\text{Se}$ , a shift in photoconductivity and photoluminescence maxima toward the short wave side are also observed. This effect is explained as the result of the formation of a layer at the near-surface region of the crystal. The layer has a large forbidden zone width owing to the combining of the near-surface layer of the cadmium solid solution. Raman spectroscopy is presently being used widely to study concentration changes in phonons and semiconductor solid solutions whose composition may change

following a laser pulse of sufficient power. It thus seemed interesting to study the effects of this action on semiconductors by using Raman spectroscopy along with the photoelectric and photoluminescent methods. In the present work a study was made of  $\text{Cd}_{0.8}\text{Mg}_{0.2}\text{Te}$  monocrystals obtained by melt recrystallization. Molar composition was ascertained by X-ray phase analysis. The study confirmed the formation of a layer having a large forbidden zone width and a tellurium film in the near-surface region of the aforementioned crystal following ruby laser irradiation. Figures 2; references 14: 9 Russian, 5 Western.

UDC 537.312.620:669.293

**Resistance Ratio of  $\gamma_s$  in Surface Layer of Superconducting Niobium**

18410335c Moscow *POVERKHNOT: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 3, Mar 88 (manuscript received 23 Apr 87) pp 96-100

[Article by I. V. Matveyev, S. B. Bugorskiy and Ye. A. Khalyavin, Rare Metal Industry Scientific Research and Design Institute, Moscow]

[Abstract] Superconducting niobium is a promising material for a number of applications in the Meissner state where the penetration depth of the electromagnetic field into the metal is limited to hundredths of a micron. At this depth, a higher concentration of impurities and surface defects is concentrated. The methods for controlling this therefore need improvement. Initial results have been reported in another work on utilization of "relative residual surface resistance",  $\gamma_s$ , for the integral evaluation of surface quality in conventional terms of resistance ratio. According to these results, the magnitude of  $\gamma_s^{-1}$  may be expressed as a linear function of the third critical field  $H_{c3}$ . In the present work results are compared for determining  $\gamma_s$  with the results of several other methods for electrophysical surface control, particularly with data on surface energy losses in the vicinity of the first critical field,  $H_{c1}$ . The results demonstrate that for reliable control of the surface quality of superconducting niobium experimentally obtained values of  $H_{c3}$  may be conveniently expressed in terms of relative residual resistance,  $\gamma_s$ , for purposes of a direct comparison of bulk values of  $\gamma_v$ . Figures 3; references 21: 11 Russian, 10 Western.



UDC 631.85:631.86:632.951.1:630.232.32

**Effectiveness of Phosphorus and Organic  
Fertilizers Combined With Fumigation in Growing  
Pine and Fir Seedlings**

*18410003a Moscow AGROKHIMIYA in Russian No 6  
Jun 88 (manuscript received 1 Jul 87) pp 29-35*

[Article by A.B. Yegorov, Leningrad Forestry Scientific  
Research Institute]

[Abstract] Soil fumigants such as carbathione, thiazone,  
and ditrapex are applied to nursery seedlings to combat

weeds and other plant pests. Fumigation also has a beneficial effect in stimulating soil microflora after a brief period of lowered biological activity. A 6-year study of combining fertilizers with carbathione, thiazone, and ditrapex in Leningrad oblast shows that pine and fir seedlings suffer a phosphorus deficiency if the phosphorus pentoxide content in the soil falls below 8-10 mg per 100 g due to a temporarily negative effect of the fumigant on mycorrhiza formation and a high mineral nitrogen content in the soil following fumigation. Mobile phosphorus should then be added. Figures 3; references 18: 14 Russian, 4 Western.

UDC 662.731:665.442.9

**Chemical Composition and Pharmacological Properties of Peat Extract**

18410002a Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
15 Sep 87) pp 35-40

[Article by P. I. Belkevich, Ye. F. Dolidovich, L. S. Sheremet, and Ye. A. Yurkevich, Peat Institute, Minsk]

[Abstract] Naturally occurring georganic substances such as healing mud, petroleum extracts, peat, organic muds, etc., have always attracted the attention of scientists and medical personnel as sources of biologically active substances of beneficial value to the organism. The biological activity of these substances becomes more pronounced at higher concentrations and with improved methods of purification and elimination of extraneous material. Thus there is interest in isolating the biologically active substance in peat, separating it into constituent classes of compounds, determining the biological activity of the resulting components, and establishing any connections between their chemical composition and the healing properties of the peat. A study examined a crude peat wax obtained by benzene extraction of bituminous top layer peat. This was further extracted with ethanol to yield a viscous, tarry, brown-colored substance that was then subdivided by ion exchange chromatography into acid and neutral fractions. These were then investigated by thin-layer chromatography and the hydrocarbon, acid, alcohol, carotinoid, phenol-carboxylic acid, and ester contents determined. Biological activity of the extract such as toxicity, antiinflammatory, antimicrobial, antifungal, and antiviral activities were determined. The results of the study indicate that the biological activity of the ethanol extract is closely related to its chemical composition and that, by altering the conditions for preparing the extract, it is possible to obtain extracts having predetermined therapeutic properties. A number of cosmetic and medicinal preparations have been derived from this base. Figures 3; references 19: 18 Russian, 1 Western.

UDC 541.128:24:553.541

**Phase Transformations of Iron-Containing Components in Processes of Autooxidation and Spontaneous Combustion of Dictyonemic Shale**

18410002b Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
2 Jul 87) pp 41- 52

[Article by B. Ye. Naumov, I. V. Aleksandrov and Yu. B. Voytkovskiy, Chemical Technology Institute imeni D. I. Mendeleev, Moscow]

[Abstract] Phosphorite overburden in the ESSR contains kerogen-containing argillite, a dictyonemic shale capable of active spontaneous heating and combustion. In the Maardu deposit there are about 15 fire foci per million

tons of dictyonemic shale dislocated due to mining operations, i.e., approaching that of the Central Asian coal deposits in terms of fire hazards. Intense autooxidation and spontaneous combustion has resulted in extensive pollution of the atmosphere (by sulfur dioxide, hydrogen sulfide, carbon monoxide, and other products of pyrolysis and combustion), water pollution from heavy metal ions, and thermal and chemical pollution of the upper (potentially soil-forming) layers of the tailings. The solution of this problem has taken on additional urgency due to the imminent working of huge phosphorite-shale deposits along the coastal regions of the Gulf of Finland. In the present work a summary is presented of the accumulated experimental material on the origin and prevention of endogenic fires in waste heaps containing dictyonemic shale and the phase transformation mechanism of the iron-containing components of the shale during spontaneous combustion. Apparently, the autooxidation takes place on disruption of the natural status of the dictyonemic shale, which progresses into spontaneous combustion. Two iron-containing products of the initial stages of phase transformation, siderite and pyrrhotine, are formed under the conditions of autooxidation of the shale, and a mechanism for their formation is proposed. Figures 4; references 17 (Russian).

UDC 541.128.24:553.541

**Endogenic Fire Hazard of Dictyonemic Shale in Tailings of Maardu Phosphorite Deposits**

18410002c Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
2 Dec 87) pp 53- 62

[Article by I. V. Aleksandrov and B. Ye. Naumov, Chemical Technology Institute imeni D. I. Mendeleev, Moscow; Geology Institute, ESSR Academy of Sciences]

[Abstract] Open pit mining of phosphorite deposits in the Baltic Sea area has the problem of dictyonemic shale being present in the tailings. This shale has a tendency for spontaneous combustion, causing endogenic fires that contaminate the environment and destroy reforestation efforts on the tailings heaps. Prolonged exploitation of the Maardu phosphorite deposit in the Estonian SSR indicates that large volumes (36 percent of the total tailings) of dictyonemic shale are present in the fault formations of the inner pit. Research is needed to develop a fire-safe and ecologically clean technology for the specific conditions of open pit mining of phosphorites in Baltic Sea area platform deposits. The present work summarizes many years' worth of experimental observations of spontaneous heating and combustion of dictyonemic shale in tailings heaps. Electrochemical, radiation, and thermometric testing methods were used in making the observations. Radioactive logging of bore holes appears to be a promising method for determining the presence and scale of radionuclide distribution in time and space in newly formed technogenic accumulations of tailings heaps. Electrophilic the surfaces of tailings heaps makes it possible to detect focal points of

spontaneous heating during the early stages of development of spontaneous combustion, thereby making it possible to take preventive measures and evaluate the effectiveness of new fire safety technology. Figures 3; references 8 (Russian).

UDC 533.96:547.98

**Tannins From Weathered Fussain Brown Coal**  
18410002d Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
2 Nov 87) pp 63-67

[Article by E. P. Buryakova, A. I. Galchenko, I. M. Potapova, and Z. A. Romyantseva, Chemistry Institute, Dushanbe]

[Abstract] The tannin content in certain woody plants is as high as 12-30 percent in the bark and 24-60 percent in the fruits and galls. Natural tannins occur as a complex mixture of aromatic compounds having some hydroxy groups, part of which are glycolized with carbohydrates. Tannin molecules may be classified by their degree of complexity into hydrolyzable and nonhydrolyzable (condensed) groups. The hydrolyzable tannins are further subdivided into gallic and ellagic tannins. Hydrolysis of tannins results in gallic acid, whereas hydrolysis of ellagic tannins results in both ellagic and gallic acids. Condensed tannins have a more complex structure. Tannins are known to inhibit enzymes and suppress the growth of many fungi and pathogenic organisms, which enables them to act as preservatives during the decomposition of plant residues. Since only one reference could be found on the participation of tannins in coal formation, a study examined the water-soluble portion of an alcohol-benzene extract of demineralized weathered fusain brown coal from the Shurab deposit of Tadzhikistan. Chromatography indicated the presence of hydrolyzable tannins. Acid hydrolysis of the latter causes them to split into gallic acid and carbohydrates (mono- and disaccharides). The data demonstrate that the basic structure of tannins present in the initial plants that formed the brown coal remained preserved. Figures 3; references 11 (Russian).

UDC 662.642:541.6

**Effect of  $\gamma$ -Radiation on Structure and Reactivity of Brown Coals**  
18410002e Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
18 Mar 87) pp 68-73

[Article by G. B. Skripchenko, V. I. Sekriyeru, V. V. Klinkova, Yu. N. Nedoshivin, Z. S. Stutkina, and V. A. Rudoy, Mined Fuels Institute]

[Abstract] There has recently been a resurgence of interest in the effects of  $\gamma$ -radiation on coal. It has been observed that this radiation affects heat resistance of

brown coals and the nature of their paramagnetic sites. In the present work infrared spectroscopy, electron paramagnetic resonance, and thermal analysis were used to study the effects of  $\gamma$ -radiation on the structure, reactivity, and thermal breakdown of Berezov and Borodin brown coals from the Kansk-Achinsk basin. Growth in paramagnetic sites, change in chemical structure, and increased reactivity were observed at low dosages (50-100 kGy). At high dosages (100-150 kGy), on the other hand, the carbon structure stabilizes. Figures 4; references 17: 14 Russian, 3 Western.

UDC 665.642.4

**Stock for Electrode Coke Obtained From Coal Hydrogenation Products**  
18410002f Moscow KHIMIYA TVERDOGO TOPLIVA  
in Russian No 4, Jul-Aug 88 (manuscript received  
17 Dec 87) pp 102-107

[Article by M. D. Navalikhina and N. V. Koroleva, Chemical Technology Institute imeni D. I. Mendeleyev, Moscow]

[Abstract] In recent years, it has been necessary for the USSR to sharply increase its output of high-quality electrode coke, one of whose most important characteristics is a low sulfur content (0.2 to 1.0 percent by weight). Graphitized electrodes, which are needed in the electric steel-making industry and as high-quality anodes in nonferrous metallurgy, must be made from low-sulfur hydrocarbon stock by employing special methods. At the present time, such stocks are obtained exclusively from petroleum and its derivatives and from coal tar. With the scarcity of low-sulfur crudes, it has become promising to use crudes containing 0.5 to 2.2 percent sulfur, although production of high-quality electrode coke from the straight-run residues of such crudes is impossible without extensive development and use of auxiliary processes such as catalytic hydrofining and desulfurization. Large-scale processes for the hydrosulfurization of petroleum refining bottoms stocks are lacking in the USSR. It has been demonstrated previously that it is possible to obtain hydrogenates containing 0.02 to 0.12 percent sulfur by hydrogenation of coal containing 0.28 percent sulfur in the presence of nickel catalysts modified with heteropoly compounds. The present work demonstrated the feasibility of obtaining low-sulfur hydrocarbon coke stock (containing 0.02-0.14 percent sulfur) by the hydrogenating brown coals in the presence of a promoted nickel-aluminum catalyst. Figures 3; references 14: 12 Russian, 2 Western.

**Beta-Polyoxybutyric Acid Developed as Polyethylene Substitute**

18410069a Moscow SOVETSKAYA ROSSIYA  
in Russian 10 Nov 88 p 2

[Article by N. Dombkovskiy: "Is It the End for Polyethylene?"]

[Text] When chemists managed to establish production of a substance that even a child would recognize today, there were no bounds to the joy of mankind. Polyethylene—such was the name given to the new substance—is light and strong, it is disdainful of rather substantial loads, and it took over the national economy with a bang.

But a few years later the unrestrainable euphoria began to yield to concern. Polyethylene does not break down in nature for centuries, and many millions of tons have already been accumulated.

Soviet scientists made a most important breakthrough in new technology. They managed to obtain a substance that is not inferior to thermoplastic material but is absolutely harmless. Here is what Latvian SSR Academy of Sciences Academician M. Bekker, deputy director for scientific work of the Microbiology Institute of the Latvian SSR Academy of Sciences, had to say about it:

"The new substance is called beta-polyoxybutyric acid. It is a product of the vital activities of a certain strain—that is, variety—of soil bacteria. It is interesting that this acid can be melted at a temperature just a little less than 200 degrees, and it is extremely easy to make various objects out of it—packaging for foodstuffs, and the like. But the principal merit of the material is that it is biologically absolutely harmless.

"Under the influence of the environment, and the vital activities of man and other living organisms, after a certain while the new biopolymer simply decomposes, leaving no traces. This is the property that promises a brilliant future for it."

UDC 678.742.23.01.046

**Properties of HPPE-Based Composites With Spent Iron-Chromium Catalyst**

18410034a Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 14-15

[Article by I. V. Popik, M. K. Frolova, R. Sh. Derevyanko, L. V. Kudinova, S. P. Tverdokhlebov, and Ye. N. Shevchenko]

[Abstract] A study examined the properties of a composite material based on high-pressure polyethylene containing spent iron-chromium catalysts. When mixed with a 0.5 percent plasticizer, the polymer loses all fluidity after 150 hours of exposure to light. The spent catalyst apparently adsorbs active chromium anions in

the surface layer and fills free vacancies, thereby decreasing the reactivity of iron oxide compounds, improving the structural stability of the polymer composite material, and preventing the interaction of oxygen in the air with the carbon chain of the polymer during photooxidative aging. The composite material produced has satisfactory mechanical properties and good color stability. References 2: Russian.

UDC 678.675'126-678.01:536.495

**Influence of Heat Treatment on Polyamide Membrane Properties**

18410034b Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 24-25

[Article by S. I. Kuperman, L. A. Vaskova, N. P. Leksovskaya, N. P. Yakovleva, I. G. Ruban, O. I. Nachinkin, and Ye. A. Krayukhina]

[Abstract] Membranes were produced from polyamide resin, heat treated at 50-160°, and examined under an electron microscope. The membranes were soaked in water and mechanically tested. The testing indicated a reduction in tensile strength. The membranes are quite weak when heated to 140° in the moist state. Heat treatment apparently reduces the molecular mass of the membrane by destroying the polyamide (including breaking the chain), increasing the capability for swelling, and thus causing deterioration of the physical and mechanical properties of the moist membranes after heating. Figures 2, references 3: Russian.

UDC 678.686.01:66.095.262.539.389

**Relaxation Properties of Epoxy Polymers**

18410034C Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 25-27

[Article by P. A. Bilym, N. G. Popova, L. Ya. Moshinskiy, V. A. Sergeyev, and V. I. Nedelkin]

[Abstract] A study examined the nature of the relaxation of residual stresses in epoxy reticular polymers produced by the polymerization of type ED-20 epoxy resin in the presence of BF<sub>3</sub> with amines. The residual stresses were found to be determined by the type of catalyst used. There was no clear correlation between the activation temperature of the curing of the epoxy composition and residual stress. The polymerization temperature of epoxy oligomers significantly influences the formation of the reticular structure. The residual stresses and the degree of their relaxation are determined by the prehistory of the epoxy polymers and are related to their relaxation properties. Figure 1, references 7: 6 Russian, 1 Western.

UDC 678.742.23.0331:536

**Thermophysical Properties of HPPE-Based Composites With Spent Catalysts**

18410034d Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 27-28

[Article by G. A. Savchenkov, I. V. Popik, V. A. Krasnov, A. L. Fedotova, T. P. Lysenko, and K. I. Rzheshkevskiy]

[Abstract] A study examined the thermophysical properties of composites based on high-pressure polyethylene that contain spent catalysts of various compositions that have been preliminarily crushed in a ball mill. The composites were found to have higher a heat conductivity than nonfilled HPPE does. Figure 1, references 5: Russian.

UDC 678.686:678.684.82:669.14:620.179.4

**Influence of Conditions of Formation of Adhesive Joint Between Epoxy-Thiokol Compound and Steel on Its Strength**

18410034e Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 31-33

[Article by A. V. Viksne, L. K. Rentse, V. M. Koryukin, and M. P. Bereza]

[Abstract] A study examined the influence of technological factors on the bonding strength of an epoxy-thiokol compound with steel. The method of substrate surface preparation, its cleanliness, and the conditions of the hardening of the epoxy-thiokol composition applied to the protected surface significantly influenced the adhesive capability. The strength of the protective layer depends largely on the degree of cross-linking and the defect content of the epoxy compound microstructure. Even slight quantities of machine oil on the surface decrease the adhesion. Regardless of substrate surface treatment, adhesive joints treated at 80° for 24 hours have stronger adhesion, probably associated with the change from adhesive to cohesive fracture with increasing heat treatment time and temperature. The best-quality joints are those produced by sand blasting the surface and forming the adhesive joint at 80° for at least 24 hours. Figures 2, references 3: 1 Russian, 2 Western.

UDC 678.743.4:620.178.162

**Specifics of Film Formation, Friction, and Wear of Fusible Fluoroplastics in Friction With Steel Without Lubricants**

18410034f Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 35-38

[Article by L. V. Vishnyakova, K. G. Gan, and S. Ya. Khaykin]

[Abstract] A study examined the friction, wear, and film formation upon friction of fusible fluoroplastics with steel without lubricant as well as the influence of various

fillers, both structural and antifriction, on wear resistance and the friction coefficient. Two friction modes were found: a normal mode with deformation of a thin film on the counterbody and a catastrophic mode with the formation of a thick film. The coefficient of friction and wear of the polymer depend essentially on the friction mode. Fillers can be classified according to their ability to stimulate or inhibit the transition to the catastrophic mode. The introduction of polyimide oligomer and fiber, glass, and particularly carbon fibers improved the wear resistance of the polymer. Aroplast, bronze, and glass fiber had little influence on wear resistance. Filler contents of 0.5-5 percent greatly increased polymer wear. The best results were obtained by the use of boron nitride, which was superior to molybdenum disulfide in this application. Figures 4, references 9: 7 Russian, 2 Western.

UDC 678.675\*126.046.01.539

**Influence of Filler on Structure and Properties of Incompatible Polymer Mixtures**

18410034g Moscow PLASTICHESKIYE MASSY  
in Russian No 9 Sep 88 pp 45-46

[Article by A. N. Kamenskiy, T. V. Ingerova, O. B. Ushakova, and O. I. Abramushkina]

[Abstract] Mixtures of polyamides with high pressure polyethylene were studied. The addition of HPPE to PA decreases the tensile strength slightly, but it significantly increases impact toughness and decreases water absorption. The addition of chalk also decreases the tensile strength but increases the modulus of elasticity in extension and the impact toughness while slightly increasing water absorption. The filler particles apparently act as an adhesive interlayer; they improve adhesion between the incompatible polymers and increase the interaction between them. The introduction of a filler to a mixture of incompatible polymers can therefore modify the properties of the individual phases and increase the interaction between the polymers at the phase division boundary. Figure 1, references 5: 4 Russian, 1 Western.

UDC 547.458.81:539.2

**Equilibrium Rigidity of Cellulose Molecules In FeNa Tartrate Complex Solution**

18410051A Riga KHIMIYA DREVESINY in Russian  
No 4 Jul-Aug 88 (manuscript received 25 May 87)  
pp 10-14

[Article by G. M. Pavlov and N. A. Shildyayeva, Leningrad State University]

[Abstract] A study examined the translational friction and characteristic viscosity of cellulose molecules of various molecular masses in an alkaline solution of FeNa tartrate complex. Equations were derived for calculating the viscosity within the range of  $M_{SD} \cdot 10^{-3}$  between 6 and 635. It was concluded that the effect of the excluded



volume may be ignored when examining the hydrodynamic properties in the FeNa tartrate complex. Figures 4, references 22: 10 Russian, 12 Western.

UDC 547.458.81

**Another Possible Way of Increasing Kinetic Stability of Solutions of Mixtures of Cellulose and Its Derivatives With Synthetic Polymers**

18410051b Riga *KHIMIYA DREVESINY* in Russian  
No 4 Jul-Aug 88 (manuscript received 2 Apr 87; after revision 11 Aug 87) pp 24-30

[Article by T. A. Savitskaya, L. A. Knytikova, D. D. Grinshpan, F. N. Kaputskiy, S. P. Firsov, and R. G. Zhibankov, Scientific Research Institute of Physicochemical Problems; Belorussian State University imeni V. I. Lenin; Institute of Physics, Belorussian Academy of Sciences]

[Abstract] This article presents the results from a study of the effect of adding a preliminarily precipitated mixture of polymers on the kinetic stability of solutions of mixtures of cellulose and its derivatives with the same synthetic polymers. The kinetic stability of the solutions of various polymer pairs increases significantly when 25-50 percent of the initial polymers are replaced with an equal quantity of a reprecipitated mixture of the same polymers, the effect appearing most clearly if the solution contains cellulose or its derivatives as one of the components. The stabilization effect begins to appear when the content of reprecipitated mixture reaches 25 percent of the total polymer component content in the solution. The results of the experiment indicate that reprecipitation causes conformational transformation of cellulose acetate and chlorinated polyvinyl chloride macromolecules. Association of molecules with altered conformation is difficult, and layer separation in a solution containing the reprecipitated mixture occurs later than in a solution of the initial polymers. Figures 3, references 12: 11 Russian, 1 Western.

UDC 634.0.863:547.458.81

**Transformations of Plant Material Polysaccharides in Presence of Acid Catalysts. 1. Hydrolysis of Cotton Cellulose in Concentrated Acetic Acid Solutions of Sulfuric Acid**

18410051c Riga *KHIMIYA DREVESINY* in Russian  
No 4, Jul-Aug 88 (manuscript received 2 Apr 87; after revision 11 Aug 87) pp 24-30

[Article by T. A. Savitskaya, L. A. Knytikova, D. D. Grinshpan, F. N. Kaputskiy, S. P. Firsov, and R. G. Zhibankov, Scientific Research Institute of Physicochemical Problems; Belorussian State University imeni V. I. Lenin; Institute of Physics, Belorussian Academy of Sciences]

[Abstract] This article reports a study of the effect of adding a preliminarily precipitated mixture of the polymers on the kinetic stability of solutions of mixtures of

cellulose and its derivatives with the same synthetic polymers. The kinetic stability of the solutions of various polymer pairs increases significantly when 25-50 percent of the initial polymers are replaced by an equal quantity of a reprecipitated mixture of the same polymers. The effect appears most clearly if the solution contains cellulose or its derivatives as one of the components. It was concluded that processing the cellulose with concentrated acetic acid solutions of sulfuric acid at 0°C results in an accumulation of inverted polysaccharides. The reaction process is a monomolecular process in which the cellulose acts as a base with the basicity constant  $K_b = 4.06 \cdot 10^{-8}$  mol/l. The true rate constant of its decomposition under these conditions is  $4.4 \cdot 10^{-3} \text{ min}^{-1}$  at 0°C. Figures 3, references 6: 5 Russian, 1 Western.

UDC 678.4.056.38:621.643

**Covering for Equipment Being Transported at Below-Zero Temperatures**

18410329a Moscow *KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE* in Russian  
No 3, Mar 88 p 33

[Article by engineers V. A. Burak and F. A. Trifonov]

[Abstract] The Fuel Refining and Chemical Machine Building All-Union Scientific Research Institute has been conducting research on the development of frost-resistant rubberized coverings using serially produced products made from methyl styrene and isoprene rubbers. The design of the rubberized coverings enables them to withstand below-zero temperatures. This is achieved by employing an intermediate layer of soft rubber that serves to compensate for the difference in the linear expansion coefficients of metal and ebonite hard rubber. Three design variants employing different grades of ebonite and adhesive were tested in a thermobaroclave at atmospheric pressure and under a vacuum at temperatures ranging from plus 2 to minus 50, degC. The results indicated that the rubberized coverings are capable of withstanding these temperatures without damage or change in hardness. The coverings are recommended for use in transporting chemical equipment at temperatures to minus 30°C.

UDC 678.674'41'5.01:539

**Properties of Compositions Based on Polycarbonate Containing Graphite Filler**

18410329c Moscow *PLASTICHESKIYE MASSY* in Russian  
No 3 Mar 88 pp 31-32

[Article by D. I. Gventsadze, Dzh. N. Aneli, I. G. Mamasakhlisov, and I. P. Kaverkin]

[Abstract] Antifriction materials may be obtained from heat-resistant polymers such as polycarbonate. Adding molybdenum disulfide and graphite as filler reduces the friction coefficient, although this also results in a drop in

the strength characteristics of the composition. It therefore appeared interesting to study the effect of the structure of the composition on its strength and friction properties. A composition was chosen that consisted of Diflon polycarbonate containing graphite particles 0.1-0.5  $\mu\text{m}$  in diameter and milled carbon fiber particles 0.1-2.0 mm long. The latter were added to the composition in amounts of 10, 30, and 75 percent. The microstructure of the composition was changed by varying the filler content and the hot pressing conditions. The impact strength, breaking stress, and friction coefficients were determined. The results show that it is possible to regulate the microstructure of a polycarbonate composition material and thereby improve its physicomechanical properties by altering the preparation conditions. Figures 3; references 4 (Russian).

UDC 541.144.8

#### Kinetics of Polymer Film Radiation Etching Process

18410335a Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 3, Mar 88 (manuscript received 13 Apr 87) pp 70-77

[Article by K. A. Valiyev, T. M. Makhviladze and M. Ye. Sarychev, General Physics Institute, Moscow]

[Abstract] The effect of direct etching of polymer films by low-intensity electromagnetic (vacuum ultra-violet [VUV], X-ray) and corpuscular (electron and ion flux) radiation has been studied actively for microelectronics technology purposes. Experiments demonstrated that the kinetics of the process is a function of the composition of the atmosphere in which the etching takes place. VUV etching under oxygen results in having a large portion of the film etched in the stationary mode at constant speed. However, when etching with any of the other above methods of radiation under a vacuum and beginning at low doses, the etching speed diminishes in a manner that is inversely proportional to the dosage and obeys the logarithmic law of the increasing thickness of the etched layer with time. In the present work a theory is developed for modifying the processes of direct etching by electromagnetic and corpuscular flux processes under a vacuum. The theory is based on the concept of the formation in the bulk of the polymer of macroradicals excited by macromolecules and low-molecular-weight volatile fragments. The latter diffuse toward the irradiated surface and enter the gaseous phase, thereby resulting in a decrease in the mass and thickness of the film. Macroradicals and excited macromolecules participate in chemical processes of polymer modification. This in turn results in a decrease in its etching speed. General expressions were derived for the relationship of etching speed and etching thickness to exposure time. These expressions were used to analyze etching kinetics at various intervals of time. An interval was shown to exist during which the thickness of the etched layer increases logarithmically, with the effective characteristic time depending on the film thickness. Etching speed

diminishes in a manner that is inversely proportional to time, and a limiting etching layer thickness was found to exist. The above results are in agreement with numerous experiments on direct etching of polymers by using various radiation sources and may be used to check the constants of experimental acts and parameters characterizing processes of modification and etching. References 14: 11 Russian, 3 Western.

UDC 541(64+183.12)532.77

#### Kinetics and Reaction Mechanism of Formation of Polyelectrolyte Complexes

18410336a Moscow *DOKLADY AKADEMII NAUK SSSR* in Russian Vol 299, No 6, Apr 88 (manuscript received 18 Sep 87) pp 1405-1408

[Article by K. N. Bakeyev, V. A. Izumrudov, A. B. Zezin, and Academician V. A. Kabanov, Moscow State University imeni M.V. Lomonosov]

[Abstract] Studying the reaction kinetics between oppositely charged polyelectrolytes is essential to extending understanding of interpolyelectrolyte complexes (PEK), simulating the processes taking place in living nature (including charged macromolecules), and especially developing an understanding of the mechanisms of biologically active substances containing linear synthetic polyions (artificial immunogens, etc.). While a great deal of experimental material has already been accumulated on the kinetics of homophased interpolyelectrolyte exchange and substitution reactions involving nonstoichiometric PEK, data on the reaction kinetics of oppositely charged chains that lead to the formation of PEK are almost nonexistent. In a Japanese source on the kinetics of such reactions when they were studied in the "stopped flow" mode, the experimental data and their interpretation are contradictory and cannot be compared with the present work where the kinetics of the reaction of polymethacrylate anions (PMA) with poly-N-ethyl-4-vinylpyridine bromide (PEVPB) cations in dilute aqueous solutions was studied by using the luminescence extinction method. A sodium methacrylate salt was prepared in such a manner that every 600th link was tagged with a pyrene luminescent label. The oppositely charged polyions were then combined. The results show that the reaction includes a rapid stage that is probably determined by the diffusion rate of the oppositely charged blocks among themselves. Figures 3; references 10: 8 Russian, 2 Western.

UDC 626.168.067

#### Acoustic Properties and Compressibility of Heat-Resistant Polymers

18410336b Moscow *DOKLADY AKADEMII NAUK SSSR* in Russian Vol 299, No 6, Apr 88 (manuscript received 2 Sep 87) pp 1409-1412

[Article by A. Ya. Goldman, V. S. Khanarin, I. V. Sysouev, A. A. Askadskiy, and Academician V. V. Korshak, Okhtinsk Scientific Research Association "Plastopolymer," Leningrad; Elementoorganic Compounds Institute, Moscow]

[Abstract] New heat-resistant polymers are promising model systems for developing future materials, and



studying their physical chemical and mechanical properties under extreme conditions (high pressures and temperatures) promises to be very interesting. The present work reports a study of the behavior of polybenzoxazole (PBO), a heat-resistant amorphous polymer with a glassification temperature of 523 K. Studies were made of the changes in volume at hydrostatic pressure and the rate and absorption of ultrasound at two fixed frequencies, 660 KHz and 2.6 MHz. Pressure was applied in 20-MPa steps at a mean rate

of bulk deformation of 0.013 percent per minute until a pressure of 500 MPa was reached. The PBO was measured at fixed temperatures of 290 and 460 K on seven isotherms. Full recovery of the measured quantities was observed after stress relief except for the 461 K isotherm. The results show that Poisson's coefficient remains constant in glassified amorphous polybenzoxazole at 200-500 MPa and at a temperature of 290-461 K. Figures 2; references 7: 5 Russian, 2 Western.

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